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U. S. DEPARTMENT OF AGRICULTURE.

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SEED OF RED CLOVER AND ITS IMPURITIES.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., July 2, 1906.

SIR: I have the honor to transmit herewith a paper on "Seed of Red Clover and Its Impurities," prepared by Edgar Brown, Botanist in Charge of Seed Laboratory, and F. H. Hillman, Assistant Botanist, Seed Laboratory.

The purpose of this paper is to emphasize the importance of the use of good seed and to make easy the recognition of the various impurities which are commonly found in it.

I recommend that this paper be published as a Farmers' Bulletin, superseding Farmers' Bulletin No. 123.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

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SEED OF RED CLOVER AND ITS IMPURITIES.

IMPORTANCE OF RED CLOVER.

Red clover (fig. 1) is the principal leguminous crop of the United States, although the cultivation of alfalfa is increasing rapidly. At the time of the last census there were approximately four million acres in red clover and two million acres in alfalfa. Red clover, appearing as it does in rotation at intervals of three to five years on the greater part of the best agricultural land of this country, plays a most important part in the maintenance of successful agriculture, and consequently special attention should be given to the quality of seed used.

THE SEED.

QUALITY.

Red clover seed of good quality is of large size, dark colored, has a decided luster, and is practically free from weed seeds. Red clover and timothy seed are sold in more grades than any other seeds, all of the large dealers offering from five to ten qualities at a time. Among these grades will be found seed that is practically free from weeds and dirt, germinating 95 to 98 per cent, as well as screenings made up of small, light-colored or shriveled brown seed with a large percentage of weed seeds, including dodder and many other noxious weeds. These extremes are well represented by the analyses of the two following samples:



FIG. 1.—Plant of red clover

Sample No.	Price paid per 100 pounds.	Percentage of weed seeds.	Percentage of dirt, sticks, and stones.	Percentage of red clover seed.	Percentage of red clover seed that germinated.	Number of weed seeds per pound.	Actual cost per 100 pounds of red clover seed that germinated.
1.....	\$5.20	25.78	26.16	48.06	18.26	139,727	\$28.48
2.....	15.00	.09	1.08	98.83	95.86	150	15.65

Sample No. 1, imported at 5½ cents per pound, contained about 18½ per cent of red clover seed that would grow, and most of this was small, light seed that would not produce vigorous plants. Large quantities of seed of this grade are constantly being imported. The quality of such seed is so poor that it is not often sold alone; neither is it re-cleaned, as the good seed it contains actually costs more than the best quality of seed. None of this poor seed is imported to be wasted, but it is mixed in varying proportions with better seed and sold to the farmer.

Sample No. 2 contained more than 95 per cent of red clover seed that would grow, and was practically free from weed seeds. In order to sow the same amount of good seed from these samples, it would be necessary to sow 5½ pounds of the poor sample to 1 pound of the other. Every time 150 weed seeds were sown with the good sample, 733,567 weed seeds would be sown with the poor one.

SIZE.

Red clover seed varies greatly in size, this being to a large extent a good indication of quality. In average seed grown in the United States there are about 300,000 seeds to the pound. English seed is somewhat larger, having about 220,000 seeds to the pound, while Chilean seed is much larger, having only 190,000 seeds to the pound. There are frequently imported large lots of screenings similar to sample No. 1 referred to above, which are made up of light-colored clover seed, very small in size, there often being as many as 490,000 seeds to the pound.

IMPORTED SEED.

The United States is a large exporter of clover seed, our annual sales ranging from 5,000,000 to 30,000,000 pounds per annum. At the same time we are importing relatively smaller quantities of seed of lower quality. In most European countries there is some sort of seed control, either voluntary or otherwise, by means of which the people have been educated to the use of seed of good quality. This leaves a large bulk of poor seed that can not be sold there, which, being offered for export at low prices, is sent to the United States and either sold as low-grade seed or, in case it is especially bad, mixed with other better seed in the so-called grading-down process before being put on the market.

A very stringent seed law has recently been enacted in Canada, prohibiting the sale there of seed containing more than a very small number of weed seeds. It contains the following clause:

The provisions contained in this act shall not apply to seed marked "not absolutely clean," and held or sold for export only.

While the provisions of this law prevent the local sale of screenings or seeds containing weeds in quantity, it encourages the exportation of such seed from Canada.

As a result of the conditions in Canada and Europe the United States, where quality is not considered as carefully as it should be and where there are no restrictions on the sale of poor seeds, becomes a ready market for low-grade seed.

That this low-grade seed is not imported for the purpose of recleaning is shown by the fact that in samples like No. 1 previously referred to the red clover seed which will grow costs nearly twice as much as the best clover seed offered on the market, notwithstanding the fact that this sample was imported at 5½ cents per pound.

Chilean red clover.—Last year about 275,000 pounds of Chilean red clover seed were imported. This is especially fine-looking seed on account of its dark color and extremely large size. It has not been given a thorough trial in the United States, and it is not certain how successful it will prove. It should, however, be carefully examined, as all of this seed which has been imported has been found to contain large quantities of a large-seeded dodder, which may prove to be a destructive clover parasite in the United States.

THE DEALER'S PROFIT ON LOW-GRADE SEED.

A large part of the seed dealer's profit is derived from the sale of screenings and low-grade seeds. At the present time, when good seed is selling for about 15 cents per pound, from 3 to 10 cents is paid for screenings, which are mixed with better grade seed in making the various qualities offered by the seedsmen. This condition of affairs is largely due to the farmer's demand for cheap seeds, and it must be expected that seedsmen will meet this demand.

ADULTERATION.

Red clover seed is not adulterated as often as alfalfa, Kentucky bluegrass, and orchard grass seed. Several samples, however, have been examined in the Seed Laboratory of the Bureau of Plant Industry which have been adulterated with from 20 to 40 per cent of yellow trefoil seed. Yellow trefoil is not cultivated in the United States, but the seed is imported in large quantities from Germany for the express purpose of use as an adulterant of alfalfa and red clover seed. A few firms are apparently responsible for all the adulterated seed of this description which is offered for sale in the United States.

MAMMOTH OR SAPLING CLOVER.

Although mammoth clover is very distinct from the common red or June clover in its habit of growth, coarseness, and earliness, the seed

can not be distinguished from that of the common red clover. It is supposed to be slightly duller, but this is an unsafe distinction to make, and the purchaser must rely entirely on the dealer in buying mammoth clover seed.



FIG. 2.—Magnifying glass.

HOME TESTING OF SEED.

Every farmer should have some kind of a magnifying glass. A convenient and cheap form is a tripod lens, which costs from 25 to 50 cents (fig. 2). A sample of seed should be thoroughly mixed and about a tablespoonful spread out on a sheet of white paper. By looking this over carefully under the lens most of the weed seeds and dirt can

be separated from the red clover seed. In this way the proportion of good seed can be estimated. Care should be taken that yellow trefoil seed is not mistaken for red clover seed.

The percentage of seed that will grow can easily be determined by means of the simple test shown in figure 3. Two dinner plates and a piece of cotton flannel or some other similar cloth about twice the size of the plates are needed for this test.

Mix thoroughly the red clover seeds which have been picked out and count 100 or 200 seeds just as they come, making no selection. Moisten the cloth well; lay one thickness on one of the plates, put the counted seeds on the cloth, lay the rest of the cloth over the seed and cover with the second plate, and keep at a temperature of about 70° F. On the second and each succeeding day take out and count the sprouted seeds. In from four to six days all of the good seeds will have germinated, indicating the percentage of seeds that would grow when the seed was sown, provided all the conditions were favorable.

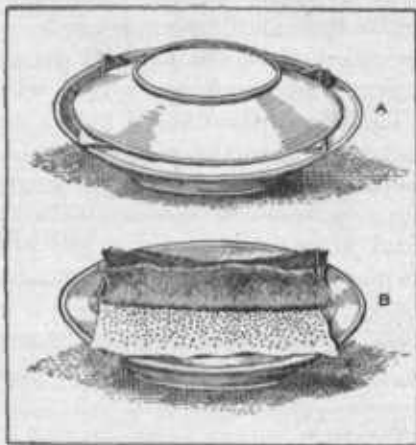


FIG. 3.—Homemade seed tester. A, closed; B, open.

SEED TESTING BY THE UNITED STATES DEPARTMENT OF AGRICULTURE.

The Seed Laboratory is prepared, as far as facilities permit, to examine without charge red clover and other seeds for the presence of adulterants or dodder, and to make tests both for germination and for mechanical purity. The test for mechanical purity consists in determining the percentage of pure seed and of weed seeds, including dodder. All samples sent for testing should be not less than two ounces in weight, should be addressed to the Seed Laboratory, U. S. Department of Agriculture, Washington, D. C., and should be accompanied, as far as possible, by the following information: Name and address of seller, year and place of growth, price paid, and name and address of sender.

CHANGE OF SEED.

Up to the present time little attention has been paid to local varieties of the common grasses and forage plants, although it is well understood that changing the seed of grain from one locality to another has a marked effect on the crop.

The Department of Agriculture is now conducting a series of experiments to determine the effect of sowing red clover seed from one region in other regions having different conditions of climate and soil. About 400 acres of land are now under cultivation in carrying on these experiments. This work is being done in 20 typical red clover sections in the United States, about 20 acres being used in acre plots in each place, each single acre being seeded with seed from a different locality. The results from the first two years' work have shown striking differences in yield, earliness, and seed production in red clover from different regions.

It is believed that as a result of this work it will soon be possible to recommend types of red clover which are especially adapted to culture in particular localities.

WEED SEEDS IN RED CLOVER SEED.

A considerable part of the impurities of red clover seed consists of weed seeds. Their presence is either incidental or intentional. Their incidental occurrence is due primarily to the weedy condition of clover meadows, by reason of which weeds maturing with the clover are harvested with the seed crop. Weed seeds qualified by size and weight to accompany the clover seed through the huller and cleaner will then appear in the re-cleaned seed in quantity proportional to their abundance in the field and the extent to which the clover seed is re-cleaned.

A long list of seeds liable to appear in commercial red clover seed is thus formed. As yet no single seed-producing locality contributes even a majority of the seeds of such a list, but owing to the widespread interchange of seed in commerce and the consequent introduction of new weeds the number to be found in any one locality is constantly increasing.

This process of weed distribution is slower than it otherwise would be, owing to the inability of certain weeds to thrive or produce seed in many localities into which they are introduced until they have passed through a period of acclimation. In the case of some weeds, however, the conditions are reversed, resulting in greatly increased productivity of plants in their new surroundings.

The most effective means for counteracting this progress of undesirable plant growth appears to lie (1) in the use of clover seed as free from weed seeds as possible, and (2) in the employment of special efforts to rid seed-producing meadows of such weeds as contribute to the impurity of the seed crop.

A knowledge of weeds and their seeds is a primary requisite to carrying out these suggestions. In the following pages some of the more important weed seeds likely to be found in red clover seed are described. Some effort is made to draw a distinction between the seeds of plants already well established in this country and some of those still found only in imported seed. This is to meet a general demand for a means of identifying home-grown seed, so that it can be purchased instead of imported seed. The presence in clover seed of weed seeds distinctively American is a strong indication of the American origin of at least a part of the seed. Likewise the presence of weed seeds distinctively foreign, so far as we are aware at present, is indicative of the foreign origin of at least a part of the seed.

First-class red clover seed should contain very few weed seeds. This means at most but a few hundred and should mean less than 100 in each pound. Even this seems a large number, but clover-seed production has not yet received that special attention which insures perfectly clean seed, and a few hundred weed seeds per pound constitutes a small number when compared with the thousands and tens of thousands of weed seeds per pound found in many samples of commercial red clover seed. In a series of tests covering 163 samples of red clover seed made in Canada in 1902^a but 2 samples contained less than 100 weed seeds per pound, and but 32 contained less than 1,000 per pound. Many of them contained from 10,000 to 40,000 weed seeds per pound. Even very small commercial samples wholly free from weed seeds are extremely rare.

^a Dominion of Canada, Dept. of Agriculture, Bulletin No. 8, New Series, 1902.

IMPURITIES IN AMERICAN-GROWN RED CLOVER SEED.

Considering first the condition of seed grown in this country, we find that of the list of from 50 to 70 kinds of weed seeds which will be represented in as many samples of red clover seed from different localities some kinds are likely to be present in a considerable number of the samples, others are apt to appear in over half of them, and a few are likely to be present in nearly every sample. The kind which predominates is largely dependent on the locality from which the seed comes. For instance, Canada thistle seed is not generally common in red clover seed, yet in Bulletin No. 8 of the Canadian Department of Agriculture, previously referred to, this seed is reported as found in more than 23 per cent of the 163 samples examined.

The size of the clover seed, depending upon the locality where grown, the character of the growing season, and the extent of the cleaning it has received, has a marked influence on the kind of weed seeds carried by it. Thus, oxeye daisy seed, which is sometimes found in small, poorly cleaned seed, is seldom present in large, well-cleaned seed. It is quite possible that the variety or strain of red clover (not now recognized by name) has much to do with the size of the clover seeds and therefore with the relation of weed seeds to such seed.

IMPURITIES IN EUROPEAN-GROWN RED CLOVER SEED.

The seed of red clover grown in Europe is subject to the same general conditions respecting weed seeds which prevail in this country; but the fact that some European seed is smaller than American seed renders it liable to contain weed seeds not likely to appear with larger seed even of foreign origin. Such seed seems to be a rather popular means of adulteration of better seed, and often appears on the American market. Many kinds of small weed seeds are brought into this country in this way, the importation of which would be prevented if the legitimate cleaning and marketing of fair-sized seed were given proper attention.

With respect to foreign-grown seed it may be considered fortunate that some of its weed seeds are those of plants which do not thrive, or at least do not fruit abundantly, in this country. Clover dodder (*Cuscuta epithymum* Murr.) is an excellent and important example of a plant conspicuously injurious and fruiting abundantly in Europe; yet, while it is equally injurious here wherever it secures a foothold, according to the best information obtainable it produces no seed in most instances.

DESCRIPTION OF THE SEED OF RED CLOVER.

The following description of the seed of red clover (*Trifolium pratense* L.) may be useful in comparing it with certain impurities, particularly yellow trefoil seed. Red clover seeds vary considerably in size, form, and color. Their length varies from nearly one-tenth to one-twentieth of an inch. Bulk seed of average size contains very few of these smaller seeds. The form generally is triangular, with rounded angles and unequal sides. Two of the sides are convex, the other, including the scar of the seed, partially concave. The color varies from deep violet to light yellow. Some seeds are violet throughout; others entirely light yellow; some present both colors.

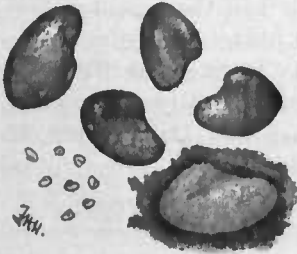


FIG. 4.—Seeds of red clover, enlarged and natural size.

The surface is smooth and in fresh seed has a slight diffused polish. Old dead seeds lose the fresh violet and yellow colors and assume a dull brown color. (Fig. 4.)

DESCRIPTIONS OF WEED SEEDS MOST COMMONLY FOUND IN RED CLOVER SEED.

The following kinds of weed seeds are those most likely to be found in any sample of red clover seed offered for sale. Some of them, when their presence is incidental, are never found abundantly.

It is hoped that the illustrations, together with the descriptions, will enable the reader to distinguish these seeds as they are found in clover seed. The descriptions emphasize the principal characteristics of the seeds. Since these seeds are all impurities of clover seed, it is evident that they do not differ greatly from average clover seeds in size and shape. Reference to their size in comparison with clover seeds is therefore given to assist in their ready detection.

YELLOW TREFOIL.

The frequent use of the seed of yellow trefoil (*Medicago lupulina* L.) as an adulterant of red clover seed makes it one of the first kinds to seek in examining a sample of commercial seed. Its identification, which is the important step, is readily accomplished with an ordinary lens, dependence being placed on the color and characteristic form of the seed. The surface of bulk seed which has been heavily adulterated assumes a greenish hue not seen in pure red clover seed.

Yellow trefoil seeds are essentially the same size as those of red clover. Their color is generally greenish yellow in fresh seed, becoming

ing brownish in older seed. They never have the violet color of red clover seeds, and the lightest colored seeds are not so light yellow as the clover seed. Many of the trefoil seeds bear a light-colored stripe extending on each side from the scar toward the broader end. Trefoil seeds are in general oval, while those of clover are triangular. The

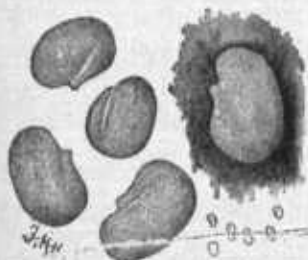


FIG. 5.—Seeds of yellow trefoil, enlarged and natural size.

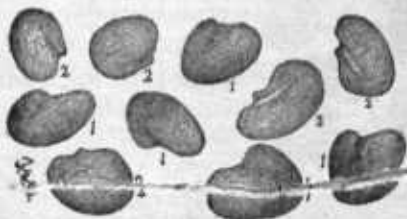


FIG. 6.—(1) Seeds of red clover, enlarged.
(2) Seeds of yellow trefoil, enlarged.

tip of the rootlet of the embryo rests within a more or less prominent projecting point beside the seed scar in the trefoil, while in the clover seed the corresponding portion is broadly rounded, forming one of the three rounded corners of the seed. (Fig. 5.) Seeds of clover and trefoil are shown together for comparison in figure 6. The seeds marked 1 are clover; those marked 2 are trefoil.

DODDER.

The pernicious parasitic plant known as dodder (*Cuscuta* spp.), an illustration of which appears as figure 7, is apparently becoming more common in this country, its seed having recently been found in 116 out of 521 samples of commercial red clover seed examined. Its frequent occurrence is no doubt largely due to the use of imported low-grade seed. Two kinds of dodder seeds are apt to be found in red clover seed in the American market.

Clover dodder.—The seeds of the well-known clover dodder of Europe (*Cuscuta epithymum* Murr.) are confined almost entirely to European-grown clover seed, since the plant generally does not produce seed in this country. The seeds are much smaller than red clover seeds, being about one-twentieth of an inch or less in diameter.

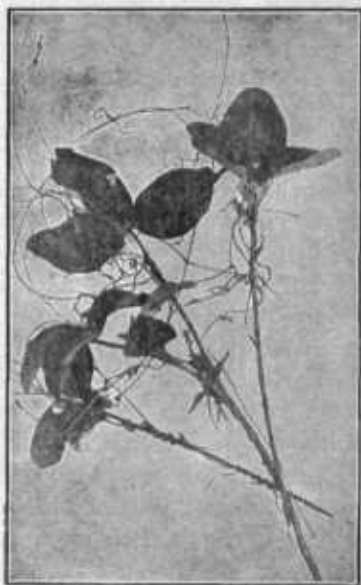


FIG. 7.—Field dodder growing on red clover.

Their small size should prevent them from being held in red clover seed, but they are often abundant in small-seeded imported seed. They are oval and but slightly flattened, or are nearly spherical. The color is light brown or dark brown, sometimes ashy gray. The surface is finely roughened and often is abundantly pitted as seen under a lens. Minute particles of clay which have become rounded often

look remarkably like these dodder seeds. They crumble to dust, however, under slight pressure.

Dodder seed under question as to identity may be boiled for some time in water, when the characteristic slender coiled embryo will emerge from the seed coat.



FIG. 8.—Seeds of clover dodder, enlarged and natural size.

The seed of clover dodder should be entirely removed from seed by the careful use of a sieve having a mesh not smaller than one-eighteenth of an inch. Comparatively little first-class clover seed will pass such a sieve. A small sieve of this kind is very helpful in testing for this dodder when present in small quantity. (Fig. 8.)

Field dodder.—The seed of field dodder (*Ouscuta arvensis* Beyrich) sometimes appears in clover seed and in some instances may be very abundant. It is a native kind which grows profusely and produces an abundance of seed. The seeds are considerably larger than those of clover dodder and so can not be entirely removed from seed without considerable loss, and only then in the case of the largest clover seed. This seed might very properly be more drended in this country than the notorious clover dodder of Europe. The largest of the seeds are about the size of the smaller clover seeds, a considerable proportion of this kind being smaller. They are yellowish, light brown, or grayish, and somewhat flattened. One face is rounded, the other angular, usually showing three unequal areas meeting at the angles. The surface is dull, finely roughened, but not pitted. (Fig. 9.) A sieve is useful in determining the presence of this dodder.



FIG. 9.—Seeds of field dodder, enlarged and natural size.

Chilenn red clover is very likely to contain another kind of dodder whose seeds, aside from the fact that they are usually darker colored, are practically indistinguishable from those of field dodder.

Dodder in the clover field is such a pernicious pest that none of its seed should be sown on the farm, and clover seed should be thoroughly examined and its purity assured before it is sown.

BUCKHORN, RIB-GRASS, OR ENGLISH PLANTAIN.

The seeds of buckhorn, also known as rib-grass or English plantain (*Plantago lanceolata* L.), are somewhat longer than average red clover seeds, but about the same width. They are oblong, rounded on one face, the other having a deep groove between the rounded infolded edges of the seed. The scar is within this groove. The surface is usually smooth, shining, and light brown.

This is one of the commonest of the weed seeds found in red clover, most of which could be removed by proper cleaning. It appears as frequently in imported seed as in that grown in this country. (Fig. 10.)



FIG. 10.—Seeds of buckhorn, enlarged and natural size.

BRACKETED PLANTAIN.

The seeds of bracted plantain (*Plantago aristata* Michx.) are similar to those of buckhorn, but slightly larger. Their surface is dull and finely roughened as seen under a lens. The rounded surface has a faint groove crosswise, near the center. The groove of the opposite face is broad and margined with white. The scar is double, white margined, and located in the center of the grooved face. The general color is reddish brown.

FIG. 11.—Seeds of bracted plantain, enlarged and natural size.

These seeds are common in American-grown red clover seed and are readily distinguished by the conspicuously marked, grooved face of the seed. (Fig. 11.)

BLACK-SEEDED OR BROAD-LEAVED PLANTAIN.

The seeds of black-seeded or broad-leaved plantain (*Plantago rugelii* Dec.) are about the length of average red clover seeds, but variable in size, some being much smaller. They are angular, black or greenish black, and dull. Of the two flattened faces one is slightly rounded, the other somewhat angular and bearing a whitish scar in its center.

These seeds are often very abundant in American red clover seed, especially such as consists of small seeds. Well-cleaned, large-seeded grades should contain comparatively little of this seed. (Fig. 12.)



FIG. 12.—Seeds of black-seeded plantain, enlarged and natural size.

CURLED DOCK.

The seeds of curled dock (*Rumex crispus* L.) vary in size to the extent that the largest are somewhat longer than the largest red clover seeds, while the smaller ones are smaller than average clover seeds. Only the smallest are removed in reeleaning red clover seed. These seeds are readily recognized, as dock seeds at least, by their sharply three-angled form and lance-like outline as they lie on one of their three equal faces. They are reddish brown and the smooth surface is more or less polished and shining. (Fig. 13.)



Fig. 13.—Seeds of curled dock, enlarged and natural size.

The seeds of a closely related and equally injurious dock (*Rumex obtusifolius* L.) often occur with those of curled dock, from which they are almost indistinguishable.

SORREL, OR SHEEP-SORREL.

The seeds of sorrel, or sheep-sorrel (*Rumex acetosella* L.), usually covered by their reddish-brown floral envelopes, are about the size of the smaller red clover seeds. They are common in low-grade small seed, but very few should appear in well-cleaned large-seeded grades.

Sorrel is so widely distributed that its seeds may be looked for in seed from any source. They are oval, bluntly three-angled, and reddish brown, either with or without the floral husk. With this husk removed the seeds are smooth and usually highly polished. (Fig. 14.)



Fig. 14.—Seeds of sorrel, enlarged and natural size.

WILD CARROT.

The seeds of wild carrot (*Daucus carota* L.) average about the same length as red clover seeds, but are somewhat narrower and considerably thinner. Their variability in size permits a considerable proportion to pass the sieves in reeleaning and thus remain with any of the grades of red clover seed.

Carrot seeds originally bear four rows of frail white spines. These are rubbed off in the process of thrashing and reeleaning, no evidence of them being left or only a few of the stumps of the spines, giving a whitish margin to the edges or ridges of the seed. With the spines removed the seeds are oblong-oval, thin, one end usually narrowed to a knob-like appendage. The general color is dull reddish brown.

One face bears two strong ridges lengthwise, alternating with three line-like, white hairy ridges. The two strong ridges and the edges bear the rows of white spines. The opposite face is smooth, or grooved in the center, and is crossed lengthwise by two very slender ridges, which sometimes bear a few white hairs. (Fig. 15.)

These seeds are common in both domestic and foreign red clover seed.

RAGWEED.

The seeds of ragweed (*Ambrosia artemisiifolia* L.) include many small specimens which pass the recleaner and remain in the marketable seed.

Most of these seeds as they appear in clover seed are easily distinguished. They are generally top-shaped and bear a crown of several short teeth from the body of the seed about the base of its narrowed apex. The body of the seed is usually more or less angled and veined.

The color is dull brown or gray. The outer husk thus described is often broken away, exposing the inner portion containing the true seed. It is oval or pear-shaped, smooth, and brown. (Fig. 16.)

WILD CHICORY.

Fig. 16.—Seeds of ragweed, enlarged and natural size.

The larger red clover seeds, some of them being narrower. They are somewhat prismatic in form, either straight or curved, and are somewhat angled lengthwise. One end is slightly rounded, while the other bears a narrow crown of scales. The surface is finely roughened crosswise, as is evident under a lens. The color varies from almost black to yellowish white. The most of these seeds are brown and somewhat mottled. They frequently occur in imported seed. (Fig. 17.)

DOG-FENNEL.

Seeds of dog-fennel (*Anthemis cotula* L.) are very common in commercial seeds generally. They are often found in both domestic and imported clover seed. They are about the length of average-sized red clover seeds, but are narrower. Screenings often contain these seeds in abundance, as they are mostly screened from large-seeded grades of red clover.



FIG. 15.—Seeds of wild carrot, enlarged and natural size.



FIG. 16.—Seeds of ragweed, enlarged and natural size.



FIG. 17.—Seeds of wild chicory, enlarged and natural size.

These seeds are somewhat club-shaped, straight, or slightly curved. They are more or less distinctly ten-ribbed lengthwise. The ribs are more or less tubercled, sometimes smooth. The color varies from brown to straw. (Fig. 18.)

SCENTLESS CAMOMILE.



FIG. 18.—Seeds of dog-fennel, enlarged and natural size.

The seeds of the plant known as scentless camomile (*Matricaria inodora* L.), which is not common in this country, are often found in certain imported seeds, including red clover. They vary in size considerably, the larger of them being about the size of average red clover seeds. They are easily recognized by their characteristic markings. They are somewhat prismatic in form, the broader end being truncate, and thin-edged. One face has three strong ribs lengthwise, two forming the edges, the other in the middle. They unite at the broader end of the seed. The opposite face has but the two marginal ribs, sometimes a partial rib at the apex. The surface of both faces between the ribs is ridged crosswise and is very dark brown or black. The ribs are usually light brown, always lighter than the spaces between them. (Fig. 19.)



FIG. 19.—Seeds of scentless camomile, enlarged and natural size.

OXEYE DAISY.

Seeds of the common oxeye daisy (*Chrysanthemum leucanthemum* L.) do not ordinarily appear in red clover seed, since they are too small and light in weight. They are rarely found in first-grade American seed, but are not uncommon in small-seeded grades from Europe. They more frequently appear in the lighter grass seeds.



FIG. 20.—Seeds of oxeye daisy, enlarged and natural size.

These seeds are sometimes as long as average red clover seeds, but are narrower. Most of them are about the length of the smallest red clover seeds. They are conspicuously marked by ten slender, longitudinal white or yellowish ribs. The surface between the ribs is black. A knoblike appendage is often present at the broader end of the seed. (Fig. 20.)

OXTONGUE.

The seeds of oxtongue (*Picris echinoides* L.) are not found in American-grown clover seed, but frequently appear in imported seed. They are somewhat similar in form and size to lettuce seed, so are

longer than clover seed, but have about the same diameter. They are marked by irregular transverse ridges, which are strongest near the broader, more pointed apex of the seed. The color is reddish yellow or sometimes light brown. (Fig. 21.)

CATMINT, OR CATNIP.

The seeds of catmint, or catnip (*Nepeta cataria* L.), sometimes appear in red clover seed, but perhaps more frequently in alsike seed. They are about the size of the smallest red clover seeds, oval-oblong, and somewhat flattened. The surface is dull and reddish brown or dark brown. One face displays near one end two white spots side by side. The surface of the seed about these spots is usually darkest. The small size of catnip seeds results in their appearing most frequently in small-seeded grades. (Fig. 22.)



FIG. 22.—Seeds of catnip, enlarged and natural size.



FIG. 21.—Seeds of ox-tongue, enlarged and natural size.

HEAL-ALL.

The seeds of heal-all (*Prunella vulgaris* L.) are more common in red clover seed than are those of catnip, to which they are closely related. They are common in both domestic and imported seed. The seeds are oval, somewhat flattened, and reddish brown, with a slight polish. Each face is crossed lengthwise by two narrow dark lines which turn to the sides near the ends and pass along the edges. The more pointed end of the seed is tipped by a whitish appendage, which is often broken off. (Fig. 23.)



FIG. 23.—Seeds of heal-all, enlarged and natural size.

PENNYROYAL.

The seeds of pennyroyal (*Hedeoma pulegioides* (L.) Pers.) are minute, being smaller than red clover seeds, but they sometimes appear in poor seed. Their presence indicates the use of screenings. The seeds are oval and vary in color from brown to black. At the pointed end the scar appears as a lighter or darker heart-shaped area. (Fig. 24.)

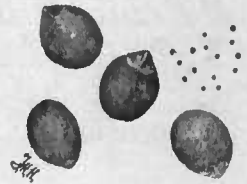


FIG. 24.—Seeds of pennyroyal, enlarged and natural size.

SPINY SIDA.

The seeds of spiny sida (*Sida spinosa* L.), which appear to be peculiar to American clover seed, are about the size of the larger clover seeds. They are oval, rounded on one face, and on the other flattened

on each side of a central ridge which projects at the broader end of the seed. The surface is smooth and the color is reddish brown, sometimes slightly mottled. Occasionally samples of red clover contain a considerable quantity of these seeds. (Fig. 25.)



FIG. 25.—Seeds of spiny sida, enlarged and natural size.

LADY'S-THUMB, OR KNOTWEED.

The seed of lady's-thumb, or knotweed (*Polygonum persicaria* L.), is one of the commonest and most conspicuous of the weed seeds appearing in American-grown red clover seed. These seeds are very uniform in size and appearance and are about the size of average red clover seeds. They are broadly oval, pointed at the smaller end, flattened, with rounded edges, and black, with a shining surface.



FIG. 26.—Seeds of lady's-thumb, enlarged and natural size.

Occasional seeds are three-angled rather than flattened. Sometimes the seeds as described are covered by brown or pinkish flower scales. (Fig. 26.)

NIGHT-FLOWERING CATCHFLY, OR CAMPION.

The seeds of the night-flowering catchfly, or campion (*Silene noctiflora* L.), are probably commonest as an impurity of alsike clover, but they often appear in small quantity in red clover seed. They are about the size of medium-sized red clover seeds and very uniform in size, form, and color. In form they are kidney-shaped, rather thick, with flattened faces. Each face has a small tubercle in the notched edge of the seed.



FIG. 27.—Seeds of night-flowering catchfly, enlarged and natural size.

The surface is minutely tubercled throughout. The color is dull gray, most of the tubercles being black at the pointed apex. (Fig. 27.)

CHICKWEEDS.

Chickweed seeds (*Alsine* spp.) are sometimes found in small-seeded grades of red clover seed. The seeds of the common American chickweed (*Alsine media* L.) are considerably smaller than red clover seeds, circular or oval in outline, flattened and rather angular on the margin. The surface is distinctly tubercled, the tubercles usually appearing in concentric rows. The color is reddish brown. (Fig. 28, a.)

Seeds of another chickweed (*Alsine graminea* (L.) Britton) are common in imported low-grade seed. These seeds differ from the last

described in having the tubercles on the surface replaced by short interlaced ridges. The margin of the seed is rounded, and the color is often gray. (Fig. 28, *b*.)

PEPPERGRASS.

The seeds of peppergrass (*Lepidium virginicum* L.) are common in many commercial seeds besides those of red clover. They are about as long and wide as average red clover seeds but thinner. In form they are oval, with one side straighter and thicker than the other.

The rest of the border of the seed is thin, forming a wing-like margin, usually lighter colored than the body of the seed, which is reddish yellow. The two faces are essentially alike, each nearly crossed lengthwise by a curved groove. (Fig. 29.)



FIG. 29.—Seeds of peppergrass, enlarged and natural size.



FIG. 28.—Seeds of chickweeds: *a*, *Alsine media*; *b*, *A. graminea*; *c*, natural size of seeds.

SPURGE.

The seeds of spurge (*Euphorbia nutans* Lag.) are very common in some American red clover seed which has been poorly cleaned or consists largely of small seeds. They are about the size of the smallest red clover seeds, and are four-sided, rounded at one end and bluntly pointed at the other. The general color is gray, sometimes light steel gray. Three of the edges are lighter, a narrow, dark groove occupying the other edge. The faces of the seed are coarsely wrinkled crosswise. (Fig. 30.)

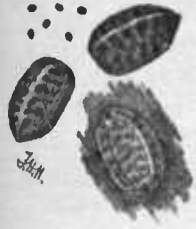


FIG. 30.—Seeds of spurge, enlarged and natural size.

LAMB'S-QUARTERS.

The plant known as lamb's-quarters (*Chenopodium album* L.) is cosmopolitan and its seeds are common in seed from all sources.

They are circular and lens-shaped; the diameter about equals the width of average red clover seeds, so they are rarely entirely removed from seed containing them. The appearance of these seeds varies greatly, owing to the presence or absence of a thin, more or less persistent seed vessel. The thin envelope gives the seed a dull black, brown, or gray appearance; sometimes it is variously broken away, exposing the shining black seed within. Often the seed coat is cracked away, showing the yellowish kernel of the seed. (Fig. 31.)



FIG. 31.—Seeds of lamb's-quarters, enlarged and natural size.

AMARANTHS, OR PIGWEEDS.

Two or three kinds of pigweed seed (*Amaranthus* spp.) may occur in clover seed. As a group these seeds are readily distinguished by their jet-black color, highly polished surface, and lens-like form. They are easily distinguished from the seeds of lamb's-quarters by their thinner edge, smaller size, and often oval form. They are not larger than the smallest red clover seeds.



FIG. 32.—Seeds of tumbling amaranth, enlarged and natural size.



FIG. 33.—Seeds of rough pigweed, enlarged and natural size.

Seeds of tumbling amaranth (*Amaranthus graecizans* L.) are smallest and almost circular in outline. (Fig. 32.) Those of rough pigweed (*A. retroflexus* L.) are usually somewhat larger and oval. (Fig. 33.)

Such small seeds in clover seed indicate incomplete reeleaning.

WILD MADDER.

The seeds of the wild madder plant (*Sherardia arvensis* L.) are commonest in European-grown seed, and they often appear in imported red clover seed. They vary in length, owing to the presence or absence of three whitish teeth borne at one end of each seed. These teeth vary considerably in length. The body of the seed is oval, rounded, and about the length of average red clover seeds. It is gray, due to the white hairs and many narrow white spots lying lengthwise of the seed. Often the three teeth are broken away, and the smaller seeds are abundant in small-seeded imported seed. (Fig. 34.)



FIG. 34.—Seeds of wild madder, enlarged and natural size.

VERVAIN.



FIG. 35.—Seeds of vervain, enlarged and natural size.

Vervain (*Verbena hastata* L.) is an American plant whose seeds often appear in red clover. They are about the length of average red clover seeds, but are much narrower. Their form is slender-oblong. One face is rounded and faintly veined, the other is flattened on each side of a central ridge. At one end of this face the large whitish scar is conspicuous. This face is more or less covered with whitish particles. A narrow marginal rim encircles the seed. The color is light reddish brown. (Fig. 35.)

The seeds of another kind of vervain (*V. urticiaeifolia* L.) also occur in red clover. They are similar to those described, but are shorter and more robust; also darker colored.

CRAB-GRASS.

Seeds of crab-grass (*Syntherisma sanguinalis* (L.) Dulac) are often found in red clover seed of low grade. The seeds are longer than red clover seeds, but are more slender, so readily remain with the smaller clover seeds, while they are mostly removed from the large-seeded grades. These seeds taper toward each end. The scale-like glumes forming the outer husk usually remain. That on one side bears three distinct narrow veins lengthwise. The one on the opposite side is shorter, being about half the length of the seed. It has three more or less distinct veins. Both are hairy unless the hairs have been rubbed off. (Fig. 36.)



FIG. 36.—Seeds of crab-grass, enlarged and natural size.

FOXTAIL GRASSES.

Both the yellow and the green foxtail grasses are common midsummer weeds of clover meadows, and their seeds maturing with the clover seed are common impurities of the seed crop.

Green foxtail.—Green foxtail (*Chaetochloa viridis* (L.) Scribn.) is perhaps the commoner of the two kinds. Its seeds are so nearly the size, form, and weight of red clover seeds that they form the commonest impurity of this seed. They are oval and somewhat flattened, the two faces being about equally convex. Some seeds retain the whitish outer covering, but most of the seeds are free from it. They are then dull and granular and either brown and mottled or light colored and tinged with green or yellow.



FIG. 37.—Seeds of green foxtail, enlarged and natural size.

The seeds as thus described consist externally of two scales of firm texture, the larger covering one face and folding over the edges of the other. Just within the edges of this scale the other presents two strips of polished surface separated by the dull, granular, and often mottled, remainder of the surface of the scale. (Fig. 37.)

Yellow foxtail.—The seeds of yellow foxtail (*Chaetochloa glauca* (L.) Scribn.) are larger and easily distinguished from green foxtail. They are somewhat larger than the largest red clover seeds, yet sometimes appear in this seed. They are mostly light colored, tinged either with

yellow or green, but sometimes are brown. They are oval, one face being strongly convex or arched, the other plane or, more strictly, concave. The convex face is finely wrinkled or ridged crosswise, the wrinkles extending over the borders of the opposite face. The scale forming the concave center of the flat face is less strongly wrinkled. The seeds as described may bear the outer, thin, whitish husk covering the flat face. One of the scales is distinctly five-veined and reaches to the middle of the convex face. Many seeds show only the torn remnants of this covering at their base. (Fig. 38.)



FIG. 38.—Seeds of yellow fox-tail, enlarged and natural size.

WITCH-GRASS.

The seeds of witch-grass (*Panicum capillare* L.) being smaller than average red clover seeds usually appear only in lots having small seeds. The seeds are oval, rounded on both sides, smooth, and highly polished. The color varies from gray to very light yellow. Five slender, light-colored lines cross one face, two crossing the central portion of the other face. Often the seeds as described are enveloped by an outer husk of two dull brown, several-veined, lance-shaped scales. (Fig. 39.)



FIG. 39.—Seeds of witch-grass, enlarged and natural size.

WEED SEEDS INDICATING THE SOURCE OF CLOVER SEED.

Positive proof of the domestic or foreign source of red clover seed is not to be looked for in the character of the weed seeds appearing in the sample; nevertheless the source is often strongly indicated by certain kinds of weed seeds taken individually or collectively.

Of the weed seeds considered in this bulletin a few, such as ragweed, spurge, field dodder, bracted and black-seeded plantains, spiny sida, lady's-thumb, and verain, indicate the American origin of the seed. On the other hand, clover dodder, scentless camomile, wild madder, and ox-tongue, as well as an abundance of wild chicory, indicate imported seed. This is not because these plants do not grow in this country, but because for one reason or another their seeds do not appear in the American seed crop.

The recognition of the source of the seed is much more complex than here indicated, involving a much larger and more general list of foreign seeds considered in the light of long experience in seed testing.